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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/709,444	05/06/2004	Chien-Jung Sun	NTCP0025USA	3443

27765 7590 11/17/2004

NAIPO (NORTH AMERICA INTERNATIONAL PATENT OFFICE)
P.O. BOX 506
MERRIFIELD, VA 22116

EXAMINER

DANG, TRUNG Q

ART UNIT	PAPER NUMBER
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2823

DATE MAILED: 11/17/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/709,444

Applicant(s)

SUN ET AL.

Examiner

Trung Dang

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☐ Responsive to communication(s) filed on ____.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 is/are pending in the application.
- 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) ____ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☐ Claim(s) ____ is/are objected to.
- 8) ☐ Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 06 May 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. ____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date ____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. ____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: ____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

2. Claims 1, 3-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Seidl et al. (US 2004/0146655 A1) in view of Schrems (US 6,580,110).

In manufacturing a trench capacitor, Seidl teaches a method for forming a deep trench comprising the steps of:

providing a substrate having a pad layer 5 thereon;
etching the pad layer and the substrate to form a deep trench, the deep trench having a sidewall and a bottom surface (Fig. 2A);
performing an atomic layer deposition (ALD) process to form a nonmetal layer 20 on the pad layer and on an upper portion of the sidewall of the deep trench, wherein the nonmetal layer is formed with a plurality of ALD process (Figs. 2E-2F and para. [0017],[0019],[0045]-[0047]).

Note that the process that forms the siloxane chain 19 on the ALD starter layer 18 is also ALD process because ALD process is understood in the art as a

process in which reactant gas is deposited in a monomolecular layer on the substrate as depicted in Fig. 1A (reference to Saenger et al. is cited to show this fact (para. [0007]) but not used in the rejection).

Seidl differs from the claims in not disclosing that after forming oxide collar **20**, the exposed surfaces of the trench are isotropically etched to form a bottle-shaped trench using the oxide collar **20** as a hard mask.

Schrems teaches a trench capacitor process in which the deep trench is widened at lower portion by isotropically etch the exposed surfaces of the trench using an oxide collar as a mask (Figs. 9B-9C).

It would have been obvious to one of ordinary skill in the art to modify Seidl's process by widening the lower portion of the trench using the oxide collar **20** as a mask because enlarging the trench in a manner suggested by Schrems would increase surface area of the trench capacitor, hence increasing the capacitance and therefore smaller structure size can be realized.

For claims 5 and 6, see col.12, lines 42-47 in Schrems for the wet etchant including NH_4OH .

3. Claim 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Seidl et al. taken with Schrems as applied to claims 1, 3-6 above, and further in view of Van Wijck (US 6,585,823).

The combination of Seidl and Schrems teaches the method as described

above. The combined process differs from the claim in not disclosing that the ALD process is performed in a low-pressure chemical deposition (LPCVD) chamber.

However, Van Wijck teaches a vertical hot wall LPCVD batch reactor that is used to deposit a film in ALD process (col. 2, lines 1-5). It would have been obvious to one of ordinary skill in the art to modify the combined process by forming ALD layers 18, 19 using the LPCVD batch reactor of Van Wijck because such reactor facilitate processing a plurality of substrates simultaneously in a single chamber, hence increasing throughput and saving production cost.

4. Claims 1-6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Divakaruni et al. (US 6,309,924) in view of Lee et al. (US 6,468,924).

With reference to Figs. 3H-3I, Divakaruni teaches a method for fabricating a bottle-shaped deep trench comprising:

providing a substrate having a pad layer 75 thereon;

etching the pad layer and the substrate to form a deep trench, the deep trench having a sidewall and a bottom surface ;

form a nonmetal layer includes a nitride layer 81 on the pad layer and on an upper portion of the sidewall of the deep trench (Fig. 3H and col. 5, lines 35-44); and

performing an isotropic etching process by taking the nonmetal layer as a hard mask to remove a portion of the sidewall and the bottom surface of the

deep trench not covered by the nonmetal layer so as to form a bottle-shaped deep trench (Fig. 3I and col. 6, lines 42-45).

Note that the wet etching using NH_4OH to enlarge the trench is an isotropic etch because the etching is an undirected etch.

The difference between Divakaruni and the claims is that while Divakaruni forms nitride layer 81 by chemical vapor deposition (CVD), the claims call for an ALD process to form the same. Lee recognizes that Si_3N_4 is conventionally formed by a CVD or an ALD method, but the CVD method is often difficult to control step coverage (col. 1, lines 25-34). Accordingly, Lee teaches an ALD process to deposit a Si_3N_4 film that possesses high quality and good step coverage (col. 5, lines 26-39). It would have been obvious to one of ordinary skill in the art to modify the teaching of Divakaruni by employing the ALD process in a manner suggested by Lee so as to form nitride layer 81 because the ALD process produces a film with superior properties than that of formed by CVD.

For claim 2, see col. 4, lines 50-57 in Lee for the limitation regarding the ALD process performed in a LPCVD chamber.

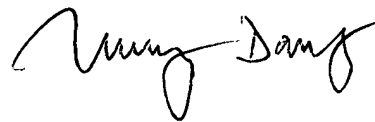
5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Trung Dang whose telephone number is 571-272-1857. The examiner can normally be reached on Mon-Friday 9:30am-6:00pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on 571-272-1855. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Trung Dang
Primary Examiner
Art Unit 2823

11/04/04

A handwritten signature in black ink, appearing to read 'Trung Dang', is written over the printed name and title.